Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

POND SEALING OR LINING, COMPACTED SOIL TREATMENT

CODE 520

(sf)

DEFINITION

A liner for an impoundment constructed using compacted soil with or without soil amendments.

PURPOSE

This practice is installed to–

- reduce seepage losses from impoundments constructed for water conservation and environmental protection

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where—

- In-place natural soils have excessive seepage rates, and
- An adequate quantity and type of soil suitable for constructing a compacted soil liner without amendments is available, or
- An adequate quantity and type of soil suitable for treatment with a soil dispersant or bentonite amendment is available for an amended soil liner.

CRITERIA

General Criteria Applicable to All Purposes

Design seepage requirements

Design a compacted soil liner for a waste storage impoundment to reduce specific discharge (unit seepage) to rates specified in the National Engineering Handbook (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D, or rates mandated in State regulations, if they are more restrictive. The required coefficient of permeability to be used in the specific discharge calculation is $1x10^{-6}$ cm/s. Lower specific discharge rates may be used at the discretion of the designer .

Laboratory testing of compacted soil liner material for a waste storage impoundment is required to document the specific discharge to meet the design seepage threshold.

Design a compacted soil liner for a clean water pond to reduce seepage to a rate that will allow the pond to function as intended.

Liner filter compatibility

Design a compacted soil liner that is filter-compatible with the subgrade on to which it is placed to prevent loss of the liner soil into larger openings in the subgrade material. NEH, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters, provides criteria on filter compatibility.

Liner thickness
The minimum thickness of the finished compacted liner must be the greater of—

- The liner thickness required to achieve a specific discharge (unit seepage) design value, or
- A liner thickness of 1 foot as required by State regulations, or
- The minimum liner thickness as shown in table 1.

Table 1. Minimum liner thickness by design storage depth.

Design Storage Depth (ft)	Liner Thickness (in)
≤16	12
16.1–24	18
24.1–30	24

Liner construction
Use methods described in the AWMFH, Appendix 10D, for liner construction. Properly seal all protrusions through the liner, such as pipes.

Liner protection
Protect the soil liner against damage caused by the effects of water surface fluctuations, desiccation and cracking, wave action, rainfall during periods when the liner is exposed, water falling onto the liner from pipe outlets, agitation equipment, solids and sludge removal activity, animal activity, penetrations through the liner, and any other activity capable of causing physical damage to the liner.

A protective soil cover is required to protect the soil liner from desiccation or erosion. The soil cover will be of a soil type, thickness, and density that is resistant to erosion and desiccation. Place a minimum 12-inch compacted layer of untreated soilover the treated liner where erosion or wetting and drying from fluctuatingwater levels exist. Under severe conditions, a protective soil cover may not adequately protect the liner from desiccation. For example during long periods, of hot, low-humidity condition, a soil cover constructed with very high plasticity soils may experience damage. Under severe conditions, additional design measures such as installation of a geomembrane in conjunction with the soil cover may be required.

Fence the structure to protect the liner from livestock damage.

Side slopes
The side slopes of the impoundment should be 3H (horizontal) to 1V (vertical) or flatter to facilitate compaction of soil on the slopes when the “bathtub” method of construction is used, as described in AWMFH, Appendix 10D. Slopes as steep as 2H to 1V can be considered if the “stair-step” method of construction as described in appendix 10D of the AWMFH is used. Steeper side slopes can be designed for isolated areas if the slope is protected.

Foundation
For a waste storage impoundment, design foundation conditions for a compacted soil liner in accordance to Conservation Practice Standards (CPSs) Waste Storage Facility (Code 313) and Waste Treatment Lagoon (Code 359). Evaluate the location and proximity of groundwater and bedrock in the design.

The liner design will include measures to protect against damage to the soil liner due to uplift water pressures if a seasonal high water table occurs at a level above that of the lowest potential level of liquid in the impoundment. Examples of protective design measures are the use of perimeter drains to lower the water table, maintaining minimum liquid depth in the impoundment, and using liners thick enough and heavy enough to resist uplift water pressures.

Evaluate the foundation for conditions such as karstic bedrock, joints, and other discontinuities of the underlying bedrock to determine the appropriateness for a compacted soil liner. Soils with highly

permeable material or fractured bedrock must be evaluated by a geologist or other individual with similar training.

Additional Criteria for Soil Dispersant Treatment

Dispersant materials

The dispersant must be tetrasodium pyrophosphate (TSPP), sodium tripolyphosphate (STPP), or soda ash unless laboratory tests using other dispersant types are used in the design.

Application Rate

For waste storage impoundments, conduct laboratory permeability tests using a dispersant of the same quality and fineness as that proposed for use. To meet the liner design threshold, use the application rate and the number and thickness of compacted soil lifts specified in the geotechnical laboratory report.

For clean water ponds, in the absence of laboratory tests or field performance data on soils similar to those to be treated, apply dispersant at a rate equal to or greater to the amount lined in table 2. Install the liner with a maximum 6-inch-lift thickness.

Table 2. Minimum Dispersant Application Rates for Clean Water Ponds.

Dispersant Type	Minimum Application Rate per 6-inch lift thickness (lbs./100 ft^2)
Polyphosphate (TSPP, STPP)	7.5
Soda Ash	15

Safety

During dispersant handling, application and mixing, personnel onsite must wear masks and goggles for protection against dispersant dust.

Additional Criteria for Bentonite Treatment

Bentonite material

The bentonite must be a sodium bentonite with a free swell of at least 22 milliliters as measured by ASTM Standard Test Method D5890, unless laboratory tests using other bentonite types are used for design.

Application rate

For waste storage impoundments, conduct laboratory permeability tests using bentonite of the same quality and fineness as that proposed for use. To meet the liner design threshold, use the application rate and number and thickness of compacted soil lifts specified in the geotechnical laboratory report.

For clean water ponds, in the absence of laboratory tests or field performance data on soils similar to those to be treated, apply the bentonite at a rate equal to or greater to the amount listed in table 3. Install the liner with a maximum of **6-inch-lift thickness**.

Table 3. Minimum Bentonite Application Rates for Clean Water Ponds.

Pervious Soil Description	Minimum Application Rate (lbs./ft^2) per 1-inch Lift thickness
Silts (ML, CL-ML)	0.375
Silty Sands (SM, SC-SM, SP-SM)	0.5
Clean Sand (SP, SW)	0.625

Safety

During bentonite handling, application and mixing, personnel on site must wear masks and goggles for protection against bentonite dust.

CONSIDERATIONS

Consider maintenance access safety and slope stability when selecting inside side slopes for design.

Consider using a composite liner system, including a geomembrane and/or geosynthetic clay liner for sites that have liquid depths greater than 24 feet.

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In areas where the liner can potentially be damaged or scoured by agitation, pumping, or other equipment access, consider installing a concrete pad over the liner.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for a compacted soil liner for a pond or a waste storage impoundment that describe the requirements for applying the practice to achieve its intended purpose. Record all required information in an engineer field book, on a plan sheet or design computation sheet, or in another appropriate location.

As a minimum, include—

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DESIGN DATA

- Completed Environmental Evaluation and subsequent requirements.
- Soils and geologic investigation including subgrade. Include gradation and classification of soils to be sealed.
- Survey and plot data: profile, cross-sections, topography, as needed.
- Design computations, including purpose of practice and references used.
  - Foundation preparation
  - Soil amendment requirements, as needed. Include laboratory test results, if needed.
  - Method of material mixing and compaction.
  - Method(s) of liner protection.
  - Quality control criteria.
  - Compaction requirements.
- Plan view of site with existing and planned features, including dimensions, distances, etc.
- Standard Cover Sheet (VA-SO-100A).
- Quantity and gradation of filter material, as needed.
- Quantities of soil liner material and soil cover material, as needed.
- Supplemental practices, such as geomembrane, as needed.
- Safety requirements.
- Virginia Conservation Practice Specifications (700 Series).
- Operation and Maintenance Plan.

CHECK DATA

- As-built survey.
- As-built plans including dimensions, types and quantities of materials installed, and variations from design. Include justification for variations.
- Completed as-built section of Cover Sheet.

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage to the compacted soil liner. This includes, but is not limited to—

- Excluding animals and equipment from the treated area.
- Repairing damage to the liner; restoring the liner to its original thickness and condition.
- Removing roots from trees and large shrubs at first appearance.

REFERENCES

USDA Natural Resources Conservation Service. 2012. Agricultural Waste Management Field Handbook (AWMFH). USDA-NRCS, Washington, D.C.

National Engineering Handbook, Part 633, Chapter 26 – Gradation Design of Sand and Gravel Filters.

USDA-Natural Resources Conservation Service. Electronic Field Office Technical Guide (eFOTG), Section IV [Online]. Available at http://efotg.sc.egov.usda.gov/

USDA-Natural Resources Conservation Service. Virginia 700 Series Construction Specifications. [On-line]. Available at http://efotg.sc.egov.usda.gov/